CLARKSON BULLETIN

Vol. V. JANUARY, 1908. No. 1.

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MEMORIAL

SCHOOL OF TECHNOLOGY

POTSDAM, N. Y.

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THOMAS S. CLARKSON MEMORIAL SCHOOL OF TECHNOLOGY

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THE SPIRIT OF ENTERPRISE*

By the Reverend Richard Mitchell Sherman, A.M.**

Let me first express my thanks for the honor accorded to me in this opportunity of speaking to the Trustees, Faculty and Students of this Institution. Let me also express my feelings of hearty congratulation upon the advance and success of this School of Technology. It well illustrates the general subject on which I shall speak this evening —namely, The Spirit of Enterprise. In the few years since the School was founded, it has made so great success, it has held its standard of scholarship and merit so high, it has demanded so high a tone of its students, that it stands unique as an example of far-sighted and determined enterprise. Other successes there are in the number of institutions of learning in this, and other countries, but their position has been reached only through long endeavor, and after trial of various plans, after many failures along with the many successes—and while it is true that the Clarkson School has had the benefit of other's experience, in making its plans and in carrying them out, it is true also that there has been shown a remarkable wisdom in dealing with that experience, and a certain firmness of purpose in holding to the high standards once set up—especially in this last half-decade; and with all these, there has not been wanting that wisdom which looks to the future, to grasp at every new idea and method which may be made use of in furthering the best interests of the School. These things make up, it seems to me, what I have ventured to speak of as the Spirit of Enterprise—that temper, that habit of mind, that is wisely conservative, not too self-satisfied, filled with the eagerness of advance and conquest, while standing firmly on the base of a wise choice.

Let me then congratulate you, Trustees, Faculty and Students, upon the high position, the exalted motive, the eminent success of the Thomas S. Clarkson Memorial School of Technology.

It is an undoubted truth that in our day, and perhaps especially in our own land, no thought is more to the front, and more effective, than the word and thought of Advance; advance in every line, physical, intellectual, moral, psychical, religious. Even opinions and parties which are in opposition in nearly all particulars yet join in this endeavor. They may not agree as to the proper direction which true advance should take, they may not have equally the enthusiasm for it —yet that there be no "standing still" is the real desire of each, and the impelling motive in each. Indeed every movement that asks for the support of men, is judged by its progressiveness, by its power to move, or the lack of it; and that movement which bears no fruit in this direction, without undue delay, will begin to lose its adherents and its standing.

Now the underlying reason of this is, of course, a sense of imperfection. However high the race may rise, in whatever direction, there is ever that deep sense of an underlying lack—a lack of the more stable elements of good that ought to be found in us, an appreciation of a certain perfection that exists somewhere in God's world, which is

*Founder's Day Address, November 30, 1907.

**Rector, Trinity Parish, Potsdam, N. Y.

not unattainable, and towards which we ought to be ever reaching. It is true that this is more readily seen and understood in the religious and moral life. There, in that part of man's general interests, in the real center of his personality, is to be found at once the reason for his desire to advance, and the power to make that advance—whether it be along the line of the spiritual, the ethical, the intellectual, or the material. For after all, man was created for God—and in the inner recess of his personality, even though it be far from its original and proposed condition of perfection, there is still a sure witness to that original perfection. We are not like the brutes around us—unthinking, unaspiring, content with the small things of the present. They experience no deep yearning for improvement, they enjoy no spirit of enterprise. Man is of a different make; in him there is a something—call it what you will—which is continually uttering a protest against whatever is his today, and urging him to go forward, to seek and to find higher things—because he feels that they are his by right, and he is, in a very real way, placed here on earth for the purpose of acquiring them. So there is seen, as the result of this spirit of unrest, a series of changes in the social world, in the political world, in the literary world, in the world of art, and of commerce, and of matter; and while these changes are not always in the line of what can afterwards be proved to be a real advance, I mean, while they may be subsequently shown with more or less reason, to have been associated with some baser motives, still the general unrest is, in its beginning, from one source, namely—from that sense of want found in human nature ever since that event which Milton speaks of as "Man's first disobedience." And that sense of want is, in its origin, from God Himself, working in us through the indwelling power of the Holy Spirit—given to man as a part of his economy to render him unsatisfied and to urge him onward and upward.

But how far short we fall of the grandeur, the absolute richness, of the real spirit of enterprise, of progress, when we allow ourselves to imagine that progressive advance has to do only with material, or even with intellectual things. To be real—it must have to do with man himself; it must be the progress of man, as distinct from the things that surround man, that he handles in one way or another, to give him luxury, and ease of life, and high position and the pleasures of existence. Yet men talk at times of the remarkable growth of the world's railway and shipping systems, of the wonderful increase of the amount of cash in our savings banks, of the rare combination of skill and science in the treatment of illness, of the improvements in sanitary conditions and methods of caring for cases of infectious diseases, of the inventions which save time and labor and cost, of the organization of the laborers, of the crusade against war, and the closer attitude of nations—and again, on the intellectual side, they rehearse the advance made in business methods, in education, in literary and artistic directions, in the greater favor shown to men of literary ideas and aspirations, in the new method of studying languages, in the new language itself, and in the new systems of spelling. Men talk of these things as if they were in themselves the special mark of progress and ask us to consider them as evidence of the greatness of our race.

But, while they are undoubtedly of great import, let us not forget that these are but outward things, mere accessories,—that our social

life may be poverty-stricken, our highest interests ignored, while we are still congratulating ourselves, and with some fair reason, upon the remarkable material and even intellectual condition of our surroundings. It is too true that we have been in danger of forgetting that we men are ourselves of vastly more value than matter, and we have allowed ourselves to spend too much time in "feathering our nest", at the cost of that greater matter—the best condition of the occupant of the nest. Material improvement is without any doubt a necessary part of human life,—and the man who is satisfied with himself and with his surroundings, who is willing to accept all things about as he finds them, to hand them on to posterity in about the same condition,—that man is an enemy to the race. Yet a far greater enemy is he who holds up the idea of material progress as being the only thing worth while, ignoring the spiritual side of our life as being of little or no moment.

Let this truth then find an entrance into your minds; and let it lodge there. In all that you may be able to do in this world, remember that you must plan, and build, and plant, and labor, for the highest good of mankind; that enterprise, to be worthy of the name and the idea, must be not a matter of material improvement only, or of personal satisfaction with a work accomplished. And the unselfish, single-minded desire to serve, for the sake of real progress, will influence and color every bit of thought and work. This intangible but potent spirit of service will most certainly have a sure and an almost visible effect upon every tangible piece of work, making it not a mere thing—so to speak—but an accomplishment for the benefit of humanity. It will not always be recognized as such, for most men are not able to understand underlying motive and see in a great work the spirit that has actuated its doing; but to some it will be evident, and, most of all, to the man who has planned and supervised its doing, bringing him a satisfying sense of having accomplished somewhat for the real progress of mankind.

To come to a more material view of our subject—You young men are to go out into the world, to take up positions of responsibility, to put into practice the lessons learned here. Ask yourselves this question, amongst others,—Is it worth while to be satisfied with a medium ambition, to plod along in a path, old and worn, well-nigh without interest and hope; to go on doing things in the old way because you are not enterprising enough to think out a better, quicker, less expensive way; to turn out work that is good enough for the present purpose, but neither rises above the old standard, nor shows any new idea in plan and construction; to lack enterprise, in short, and to be not a self-reliant, forceful, personality, but a follower?

It is true, of course, that you must work under the same laws of nature that have obtained from time unreckoned. There is no escape from the old law that "two and two make four"; nor from the result of the fact that the atmosphere exerts a pressure of fifteen pounds on each square inch of matter. These, and such like laws, one will always have to reckon with. But they are not of necessity in antagonism to the man who would work in the physical world; for he knows that he may make use of nature's laws by simply following their direction, and thus bending them to do his bidding. He builds on what has been discovered of those laws in years past, of their operation, of

their force, of their relation one to the other; and he does this, not from choice but of necessity. But he need not stop with whatever of knowledge may have come to him; for new facts are continually coming to light, new phases of the old subjects, new methods of using those old forces which were set in operation by the Almighty—"when the morning stars sang together, and all the sons of God shouted for joy." (Job 38:7.)

Witness, for instance, that remarkable triumph of patience and ingenuity shown in the work of a certain Mr. Louis Brennan, who after twelve years of almost unremitting thought and labor has at last perfected and exhibited a car which will undoubtedly become the railway car of the future. It is explained in the McClure's Magazine for December, 1907. It runs on and above a single track, on four wheels, set in line; and it is poised by means of a couple of balance wheels, placed and held in such a relation as to make a gyroscope, in which the rotation of these wheels, and their effect upon the body of the car keeps the car upright in any and every emergency, while it hurries along at the remarkable rate of from 150 to 200 miles an hour, driven by steam, gasolene or electricity. Imagine the intense satisfaction of reaching New York City from Potsdam in less than two hours' time! Now, this Mr. Brennan had to meet and overcome obstacles of every sort. Year after year, he continued his experiments, finding out from time to time something new about the laws of motion and poise, and at last he was able to declare his invention a success. But the natural laws were there all the time, only waiting for Mr. Brennan to investigate them and so learn their working. And so it is with all the laws of nature. They doubtless have many secrets which are not yet found out; which—when once discovered—will inevitably enable man to do that which is now called the impossible. For the great strides made by men of science in the past years have not exhausted the resources of nature, they have but made it evident that there are still other phases of force waiting for discovery and conquest. Old Benjamin Franklin, with his silken kite and cord, to which was tied an old key, did not find out all there was to be known about electricity. It was a happy thought, and one to be remembered with deep gratulation, that actuated little George Stephenson, the son of a collier, to attach a cord to the cut-off of a steam engine, which should make the engine do its own work in shutting off and letting on the steam for its own movement; but his thought and action did not exhaust all that was to be known about the properties of steam and the possibilities of its use.

These men were full of the Spirit of Enterprise, that temper which will not let a man sit still and content himself with things as they are, but is ever telling him that there is something better to be had, something bigger to be accomplished, "more worlds to be conquered," more people to be served, more real work to be done!

So look about you, and see if there be not some improvement to be made in the method of accomplishing some of the world's labors. Is there not a better way of building bridges? Can not a quicker method be found for boring tunnels? Is the present airship the best that can be made? Has the last word been said on the subject of the use of air-pressure? Pins, they ought to be manufactured more cheaply. Turbines—it is absurd to suppose that they are the best thing for using the expansive power of steam. Think on these things!

Yet remember, that in all you do, or attempt to do, you must be actuated by that great motive of service to mankind for mankind's betterment; that no progress can be rightly so-called unless it bring some real uplift to man, quite apart from the things that man uses in his life; that by so serving mankind you are serving Almighty God, who will indeed accept at its true valuation this service, and will—one day—when the final account-books are opened, and the actual balance is cast up, give to those who have honored Him by honoring mankind that word of commendation which everyone of us will be longing on that day to hear—"Well done, good and faithful servant."

FOUNDER'S DAY EXERCISES.

1896 — Eleventh Anniversary. — 1907.

The eleventh anniversary of the founding of the School was very appropriately observed, on Saturday, November 30, 1907. The exercises were held in the Chapel hall, at eight o'clock in the evening. They were attended by an appreciative audience of our townspeople and friends of the School, as well as by Trustees, Faculty and students and visiting alumni. The musical portions of the program were rendered by the Clarkson Tech. Orchestra, under the direction of Mr. Sherman A. Clute, '11; and the management of Messrs. Welker Brothers, '09, holders of the Musical scholarships for 1906-1908. The following program was rendered:

Program.

Overture—Selection,... ... ...Carmen-Bizet
Clarkson Tech. Orchestra.
Invocation and Scriptural Reading.
Vocal Solo—Selection,
Miss Ethel Strong.
Address:
"The Spirit of Enterprise,"
The Reverend Richard Mitchell Sherman, A.M.
Cornet Solo,... ... ...Premier Polka
Sherman A. Clute, '11.
Announcement:
Levinus Clarkson Scholarship for 1907-1908.
Selection,... ... ..."Clarkson, Our Clarkson"
Clarkson Male Quartette.
Benediction.
Finale,... ... ...Grand Mogul
Clarkson Tech. Orchestra.

The Tech. Orchestra played in an excellent manner the overture to Bizet's Opera, Carmen; and the cornet solo with orchestral accompaniment was artistically executed by S. A. Clute, '11. A vocal solo, "O Dry Those Tears," sung by Miss Ethel Strong, a graduate of the Crane Normal Institute, Class of '07, was highly appreciated. The selection, "Clarkson, Our Clarkson," a Tech. song, was rendered by the Clarkson Male Quartette with the vim of college spirit.

Announcement was made of the award of the Levinus Clarkson Scholarship, for 1907-1908. This was established on the Decennial

Charter Day, March 19, 1906. It awards one hundred dollars to the student whose record is above question, as shown by work, attendance and conduct, since entering the Tech., and who has, moreover, the promise of future professional success as an engineer. The vote of the Faculty, in sealed letter ballots, was reported under seal by the Secretary of the Board of Trustees to the Director, immediately before the exercises. Mr. Laurence J. Gorman, '09, of Waddington, N. Y., received the scholarship. Mr. Gorman, upon being called upon, came to the rostrum and in a few fitting words gratefully acknowledged the scholarship grant.

CHANGE IN THE BOARD OF TRUSTEES.

At a meeting, November 15, 1907, of the Board of Trustees of the Thomas S. Clarkson Memorial School of Technology, Professor Geo. H. Sweet resigned the office of Treasurer of the Board. In tendering his resignation, Mr. Sweet said that his action was the result of mature deliberation on his part, and asked the Board to treat his wish and determination as final and beyond recall. His resignation is self explanatory, and is as follows:

"To the Board of Trustees of the Thomas S. Clarkson Memorial School of Technology:

"After more than eleven most pleasant consecutive years as Treasurer of this Board of Trustees I now desire to withdraw from that office and lay down its work. The Clarkson School of Technology, itself now in its very infancy, is an enduring institution, here for all time, gaining in vigor, in strength, and extended usefulness as time rolls by. It is now taking healthy and deep root; its mission is one of the noblest known to mankind. On the other hand the individuals who may chance to be called to the honorable duties of administering the School's affairs, from time to time, are mere accidents, simply sentinels in the watch tower, here today, succeeded by others tomorrow. Agreeably to a well considered conviction, in duty to self and the School, that I would retire from the responsible trust of Treasurer upon reaching my seventieth birthday, I am reminded that that period in my life has arrived. Ruthless Time is now relentlessly striking off that number and entering it opposite my name in his great book.

"Thanking the members of this Board collectively and individually for their uniform forbearance and considerate kindness while serving as your Treasurer, since the initial opening of the School, in September, 1896, I herewith tender my resignation as Treasurer of the Board of Trustees of the Thomas S. Clarkson Memorial School of Technology, to take effect immediately. Sincerely yours,

(Signed) George H. Sweet."

Professor Sweet is one of the Charter members of the Board of Trustees, and has been actively identified with the school's interests since its inception and foundation as a School of Technology.* He

*See Historical Sketch prepared for the Potsdam Centennial, June 17, 1903, and revised for publication in Clarkson Bulletin, Vol. III., No. 4, October, 1906: "The Thomas S. Clarkson Memorial School of Technology, by George H. Sweet, A.M., LL.B."

still continues as a Trustee. When a representative of the Courier and Freeman, of Potsdam, N. Y., interviewed him, consequent upon his resignation as Treasurer of the Board of Trustees, he found Mr. Sweet very enthusiastic over the Tech. and its success. He said: "I have only words of praise for the Clarkson School. My active interest in the school remains unabated and my hopes for its future were never brighter. The Clarkson has high ideals of the requirements of a strictly up-to-date engineering college. Its war cry is 'second to none, peer of the best.' The Board of Trustees and the Faculty of instructors are intelligently, unitedly, and harmoniously pulling together to keep the school in the very front ranks of the best technological colleges of the day. The Clarkson now has sixty-seven young men, graduates from its various four-year engineering courses. Each one, upon graduation, received a diploma and the degree B.S., from the University of the State of New York, recognized as the highgest and most desirable degree conferring authority in the engineering world. These sixty-seven graduates all have desirable positions. They fully appreciate what the Clarkson School has done for them, and especially do they appreciate the noble generosity and thoughtful watchfulness of the Misses Clarkson, donors and founders, who have made such rare opportunities for young men possible. The present undergraduates number ninety-six (all 'regulars', no 'specials'), with a probability that the hundred mark will be reached before the close of the present college year. The Clarkson School has been winning its way since the first. Its progress and advancement in the past five years have been especially marked and gratifying. Who can foretell what record mark among technological colleges, what extended usefulness the future has in store for this Institution."

(Copy.)

Potsdam, N. Y., November 15th, 1907.

Wm. S. Aldrich, Director,
Clarkson School Technology,
Potsdam, N. Y.

Dear Sir:—

At a meeting, duly called, of the Board of Trustees of the Thomas S. Clarkson Memorial School of Technology, of Potsdam, N. Y., held at the office of the president thereof in the town and village of Potsdam, N. Y., on the above mentioned date, all of the trustees being present and voting, Frank L. Cubley, Esq., of the said Potsdam, one of the aforesaid trustees, was unanimously elected treasurer of the said Board of Trustees in the place and stead of George H. Sweet, resigned, the said election to take effect immediately.

Yours very truly,
(Signed) A. X. Parker,
President of the said Board.

Attest:
(Signed) H. D. Thatcher,
Secretary of the said Board.

The Treasurer Elect, Frank L. Cubley, Esq., has for some time been more or less identified with educational matters. In 1888, Mr. Cubley graduated from the Massena, N. Y., High School; in 1893 he received his classical diploma from the Potsdam State Normal and

Training School, and in 1897 he was graduated from the University of Rochester with the Degree of A.B. In all of his educational work, Mr. Cubley has always maintained a good standing and taken a prominent part in the proceedings of the student body. He was one of the honored men at the time of graduation from the Potsdam Normal and a Phi Beta Kappa man when graduated from the University of Rochester. During his collegiate course, he was President of the Student Body and its representative in Inter-Collegiate Councils. In 1898, Mr. Cubley began the study of law with the late Hon. John G. McIntyre, who was for several years the honored President of the Board of Trustees of this School. In 1900, Mr. Cubley commenced the practice of law in Potsdam, having been associated until January 1, 1905, with Judge T. H. Swift and Geo. W. Fuller, under the firm title of Swift, Fuller & Cubley. Since the dissolution of that firm, Mr. Cubley has been successfully practicing his profession alone. In 1907, he was elected President of the Board of Education of the Potsdam High School, and for many years he has been the Editor-in-Chief of the "Normal Magazine", the Alumni publication of the Potsdam Normal.

ST. LAWRENCE COUNTY SCIENCE ASSOCIATION.

The St. Lawrence County Science Association was organized and held its first meeting at the Clarkson School of Technology on Saturday, January 18, 1908. The following officers were elected: President, Prof. B. B. Brackett, of the Clarkson School of Technology; Vice President, Prof. Henry Priest, Dean, St. Lawrence University; Secretary and Treasurer, Prof. F. T. Owens, of the New York State Normal School. It is proposed to hold meetings monthly, the first week of each month, and at the three institutions represented in its membership, The St. Lawrence University at Canton, N. Y., The State Normal School at Potsdam, and The Clarkson School of Technology. This will be a great benefit and help to the advancement of scientific study and research in Northern New York, it having for its object the advancement of scientific thought among its members. It is open to anyone engaged in the teaching of Science, anyone engaged in any scientific occupation, or to anyone especially interested in either of the above mentioned lines of action. The club starts off with bright prospects and it is a matter of congratulation to this section that such an organization has been formed. The next meeting will be held at The St. Lawrence University at Canton, N. Y., the first week in March.

HISTORY OF EDUCATION.

A Syllabus.

By Carl Michel, Ph. D.*

1. Significance and evolution of education in primitive society. Relation to civilization. Education through experiences of life and their transmission. Social control, customs, ideals.
   Laurie: Pre-Christian education. (Longmans)

*Professor of Social Science and Modern Languages, Thomas S. Clarkson Memorial School of Technology.

Lubbock: Origin of Civilization. (Appleton)
Tyler: Primitive Culture. (Holt)

II. (a) Oriental Education; China as a type.
Relation to national ideal. Conservation of social order and customs. Education for civil service. Political and social results.

Taylor: Ancient ideals. (Macmillan)
Williams: The Middle Kingdom. (Scribner)
Martin: The Chinese. (Harper)

(b) Greek life and education.
Significance. Contrast between eastern and western civilization. Greek principle of life; religion; art and science; National games; music; gymnastics. Periods of Greek education. Organization of Athenian schools. Tendency to Individualism. Transitional forces. Emergence of the ideal of a liberal education. Spread of Greek Culture. Fusion with Roman education.

Mahaffy: Greek Life and Thought. (Macmillan)
Bosanquet: Education of the Young in Plato's Republic. (Macmillan)

(c) Roman Education.
Education as training for practical life. General characteristics. Compared with that of Greece. Ideals expressed in social organization. Hellenic influence. Organization of Roman schools. Theorists, Cicero and Quintilian.

Clarke: The Education of Children at Rome.(Macmillan)
Mahaffy: The Greek world under Roman sway "
Monroe: History of Education. (Macmillan)

III. (a) Education in Middle ages. Scholasticism and Rise of Universities. Education as discipline. Influence of Christianity. Contrast between the classic and the medieval ideal of character. Christian schools; monasticism; moral discipline. Aims, methods and educational significance and value of Scholasticism. Education as an intellectual discipline. Origin and growth of Universities. Social and intellectual organization. Chivalric education; Education as social discipline. Influence on European civilization.

Addams: Civilization in the Middle Ages. (Scribner)
Rashdall: The Universities of Europe in the Middle ages. (Oxford)
Laurie: Rise and Early Constitution of the Universities. (Appleton)

(b) The Renaissance and the Humanistic Education. Educational meaning. Significance for modern civilization. Types of humanistic schools. Humanistic conception of education. Relation of Humanism to Realism.

Jebb: Humanism in Education. (Macmillan)
Seymonds: The Renaissance. (Holt)
Woodward: Erasmus Concerning Education.(Macmillan)

(c) Reformation and Counter-Reformation and Religious Conception of Education. Educational significance. Formalism. State systems. Jesuit schools. Relation of Reformation and Counter-Reformation to humanism.

Beard: Lectures on Reformation 16th century.(Scribner)

Hughes: Loyola and Jesuit System of Education. (Macmillan)

Quick: Educational Reformers. (Appleton)

IV. Rise of Realism and Science in Education. Humanistic and realistic tendencies. Realism and Utilitarianism as opposed to humanism. Rise of conception of method in construction.

Browning: History of Educational theories. (Harper)

Laurie: Educational opinion since Renaissance. (Macmillan)

Munroe: The Educational ideal. (Macmillan)

Tendencies in Education.

(a) Psychological tendency

General characteristics. Pestalozzian, Herbartian and Froebelian Systems.

DeGuimps: Life of Pestalozzi. (Bardeen)

Felkin. Herbart's Science of Education. (Heath)

Froebel: Education of Man. (Appleton)

Pestalozzi: How Gertrude teaches her children. (Bardeen)

(b) Sociological tendency.

General characteristics. Education the process of securing stability and betterment of society. Social aspects of Pestalozzi's, Herbart's and Froebel's work. Aspect of scientific movement. Ideas of political leaders. Preparation for citizenship. Philanthropic religious movements for education. Modern State systems of Education. Industrial phase of the movement.

Youmans: Education demanded by modern life. (Appleton)

Horne: The Philosophy of Education. (Macmillan)

Horne: The Psychological Principles of Education. (Macmillan)

Vincent: The Social Mind and Education. (Macmillan)

Ward: Dynamic Sociology. (Appleton)

(c) Scientific Tendency.

General characteristics. Culture demanded by modern life. Theory of Education formulated by the natural scientists. New definition of liberal education. Connection between scientific and sociological education. Culture elements not eliminated but given a new value. Spencer. Huxley.

Youmans: Education demanded by modern life. (Appleton)

Birdseye: Individual training in the college. (Macmillan)

Hadley: Education of the American Citizen. (Scribner)

Person: Industrial Education. (Houghton, Mifflin)

Woodward: The Manual Training School. (Heath)

(d) Present Eclectic Tendency.

General characteristics. Fusion of the psychological, scientific and sociological tendencies. Current educational tendencies; expansion of curriculum; rationalizing of method; specialization in teaching; recognition of teaching as a profession. Expansion of work of school to meet new social needs. Harmonization of individualistic factor in 20th century definitions. Curriculum must change from generation to generation, as life changes.

Cubberly: Syllabus of Lectures on the History of Education. (Macmillan)

Sinclair: The Possibility of a Science of Education. (University of Chicago Press)
Munroe: History of Education. (Macmillan)
Canfield: The College Student and his Problems. (Macmillan)
Thwing: College Administration. (Century Co.)
Thwing: History of Higher Education in America. (Appleton)
Harper. The Trend in higher education. (University of Chicago Press)
Walker: Educational Discussions and Addresses. (Holt)

In addition to the foregoing references many valuable monographs and papers and articles upon special topics related to the history of education, will be found in the proceedings of the following educational associations:

National Educational Association.
National Society for the Promotion of Industrial Education.
Society for the Promotion of Engineering Education.
Association of American Universities.

ONE WAY IN WHICH BOTANY IS RELATED TO CIVIL ENGINEERING.

By Donald F. McLeod, C.E.*

Some few years ago one of the foremost civil engineers of this country prepared a paper in which he outlined a course of study for civil engineering students. Various branches of science were mentioned as being useful to the civil engineer. Botany, however, was cited as being of little use except in one of its divisions,—dendrology—which treats of trees and the structure of wood.

Not long ago, in one of the prominent educational centers of this State, at a meeting of an educational character, it was proposed to found a scientific club for the purpose of discussing and studying such scientific subjects as might be introduced by the members. It being desired to include in the club certain technical men, the opinion of a civil engineer present was requested. He said that there would be little trouble in including civil engineers as members, since their profession was connected more or less closely with most modern branches of science. Exception being taken to this statement, he asked that a scientific subject be named which was in no way related to civil engineering. One of those present at once suggested, "Biology".

While the eminent civil engineer first mentioned probably would not now try to justify his statement regarding the science of botany being of little use to a civil engineer, there are, doubtless, many in the class of the man last mentioned, who would be willing to say, off-hand, that there is no intimate connection between biology and any branch of civil engineering. The purpose of this article is to show one way in which botany, in one of its biological branches, is related to municipal engineering; viz., in the bacterial methods of purifying sewage.

When inland cities situated on small rivers, were of small population, their sewers led directly to the banks of the stream, and the

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*Professor of Civil Engineering, Thomas S. Clarkson Memorial School of Technology.

untreated sewage was discharged into the river. As these cities increased in population, the flow of sewage became so large a proportion of the flow of the stream that offense was given to riparian owners, and danger arose of injury to the health of the inhabitants of the cities down stream.

Under these circumstances, it became necessary either to find some other means of disposing of the sewage, or to purify it in some way so that the effluent could safely be discharged into the stream.

The various means of purifying sewage that have been developed are: chemical precipitation, disposal on land, septic tanks, "contact beds", aerating filters, continuous or percolating filters and zonal tray filters. In all of these except the first, the action of bacteria plays an important part.

Bacteria were first discovered about the middle of the seventeenth century. Little was learned of these so-called "animalcules" until about two hundred years later, when important discoveries regarding them were made by Spallanzani, Pasteur, and Tyndall.

Up to comparatively recent times,—as late as the year 1838,—bacteria were regarded as infusoria. This was perhaps due to the fact that many of them have appendages, flagella, which give them the power of motion, and also to the fact that chlorophyll is not secreted by them.

Study of bacteria, however, has shown that their life history is that of plants; that, like other plants, they obtain their food in simple forms. They obtain the carbon of their structure by breaking up carbohydrates, and by breaking up complex organic matters into water, carbon dioxide, and ammonia. They obtain their nitrogen from the soil in the form of nitrates, while animals obtain their nitrogen from such complex structures as albumens and albumenoids. These substances are prepared by plants and cannot directly be built up from their more elementary constituents by animals.

Bacteria may be classified as lower bacteria and higher bacteria. The former may be classified on the basis of form as cocci, round cell form, including micrococi, diplococci, streptococci and staphylocci, bacilli, rod shaped bacteria, and thread form, spirilli. Some of these are harmless, some are injurious, and some are useful. The same is true of the higher bacteria which include such organisms as leptothrix, streptothrix and cladothrix. One of the injurious effects of bacteria is the capacity which some of them have of secreting toxins, (chemical poisons), when they develop in the bodies of animals. These toxins produce disease. There is for example the diploccoccus of pneumonia, the streptococcus of erysipelas, the bacillus of diphtheria. Among some of the useful bacteria may be mentioned those on whose action certain manufacturing processes are based such as the preparation of linen, jute and hemp, and the cleaning of sponges, the preparation of indigo, the ripening of cream and cheese, the raising of dough. Also of importance are those which aid leguminous plants in forming nitrates in the soil by taking free nitrogen from the air. Tyndall said: "These low organisms which one might be disposed to regard as the beginnings of life, were we not warned that the microscope, precious and perfect as it is, has no power to show us the real beginnings of life, are by no means purely useless or purely mischievous in the economy of nature. They are only noxious when out of their proper place. They exercise a useful and valuable function as the burners and con-

sumers of dead matter, animal and vegetable, reducing such matter, with a rapidity otherwise unattainable, to innocent carbonic acid and water."

Scientists contemporaneous with Tyndall, and others somewhat earlier, had demonstrated the fact, in connection with which Tyndall himself performed many experiments, that organic matter cannot ferment or putrefy in the absence of bacteria. Pasteur divided bacteria into two kinds, aerobic, those which require the presence of oxygen for their growth, and anaerobic, those which cannot thrive in the presence of oxygen. Scientists of the present time make a third division, facultative bacteria, those which can thrive either in the presence of oxygen or in its absence.

About the first application of the action of bacteria to the purification of sewage was made about the year 1878, in France, when the "Mouras Automatic Scavenger", was introduced. The "scavenger" was a sort of closed vault, through which sewage, when continually passed, was so acted upon by the bacteria naturally present in it as to have its solid matter dissolved. The effluent was said to be in such a state of purification that it was almost devoid of smell and could be used for irrigation purposes. As a matter of fact, however, sewage subjected to such a process has been found to be insufficiently nitrified.

Tanks similar to those of Mouras were constructed in a number of places in the United States about the year 1880. Up to this time it would appear that the part taken by bacteria in the purification in sewage slowly passed through a closed tank was not understood. Even when the experiments of the Massachusetts State Board of Health—the reports of which are now classic in the literature of sewage disposal—were begun in November, 1887, the first attempts at purification were based on the destruction of the bacteria found naturally in sewage.

The Massachusetts State Board of Health carried on for several years a series of experiments, which consisted largely of passing sewage through filters of differents materials, different sizes of materials, and depths of materials, with variations of temperature and time. They found that organic material could be completely destroyed when the proper conditions were maintained for the growth of bacteria in the beds of filtering material. The conclusion come to after much experimentation was that these conditions were best provided by using beds of coarse sand about four feet deep, allowing the sewage to flow on for only part of the day so as to leave regular intervals for rest and for aeration.

Sixteen coarse sand beds, each one acre in area were constructed and operated on this principle at Worcester, Mass. It was found that each bed was capable of purifying about 100,000 gallons of sewage per day. The purification was to such an extent that the effluent was in no danger of putrefying afterward. By running the beds at about one-fifth this rate, however, an effluent was obtained to which no exception could be taken either from a chemical or bacteriological standpoint.

This method has been adopted to quite an extent along the area of glacial drift where sand and gravel are easily obtained. In the year 1905, there were eleven such plants in operation in Ohio.

Reports of the Ohio State Board of Health indicate that there are often poor results in winter, and that much trouble is given by frost.

In 1905 the plant at the Mansfield Reformatory was treating sewage on beds of crushed sand-stone at the rate of 77,000 gallons per acre per day. The Report of the Massachusetts State Board of Health for 1903 shows that in the preceding ten years the cost of intermittent sand filtration of sewage was about 43 cents per year for each unit of population.

About the time that the celebrated experiments of the Massachusetts State Board of Health were being carried on, the city engineers of London, England, were wrestling with the problem of what to do with the effluent of the tanks in which the sewage of the city was treated by chemical precipitation. It may be said here that the chemical precipitation of sewage does not produce, as the name might indicate, much change in the characteristic chemical composition of sewage. The treatment consists of adding small proportions of sulphates of iron and aluminum, with certain proportions of slaked lime, depending on the alkalinity of the sewage to be treated. Heavy precipitates of hydrates of iron and aluminum are formed. These precipitates carry down, mechanically, the solids in suspension in the sewage making practically no change in the liquid constituents, which contain sufficient bacteria to produce putrefaction when the effluent is discharged into a stream. This is one of the objections to the chemical disposal of sewage; another is the expense entailed in disposing of the solid matter, "sludge", precipitated to the bottom of the tanks. This may amount to about a ton per day for each one thousand inhabitants. In some modern plants it is disposed of by pressing it into cakes, drying it, and burning it. Others run it on to beds of earth and plough it in. As about nine-tenths of sludge consists of water, and the remainder of largely insoluble constituents, it is practically worthless as a fertilizer. At the time spoken of at the beginning of this paragraph, the sludge from the precipitation tanks at London was carried out to sea in specially constructed tank steamers.

The effluent from the tanks had up to this time been discharged into the River Thames. But as the population of the city increased, and consequently, also, the volume of flow from the tanks, such an intolerable putrefaction was set up in the river that other means of disposal had to be discovered.

Disposal by irrigating land was out of the question, as this had already been tried, about the year 1866, and the acreage then available was found too small to give a satisfactory effluent for even North London alone.

The result of the experiments with bacterial purification in Massachusetts was therefore welcomed as perhaps offering a solution of the problem. Experiments were tried with small filters. It was found that though sand and gravel produced the best clarification, more satisfactory results in the removal of dissolved organic matter were produced by coarser filtering material composed of coke or burnt ballast —burnt ballast is much like broken brick in texture, and is made by subjecting brick clay to a burning process. The best results obtained were filtration at the rate of 1,000,000 gallons per acre per day, ten times the best rate mentioned for the Massachusetts experiments, and the effluent at this rate was sufficiently purified to be discharged into the Thames, without giving offense. One should note, however, that the sewage treated had the most of its solid matter in suspension removed, as already stated, by chemical precipitation, while the Massa-

chusetts experiments dealt with raw sewage. Later, however, (1897-1900), fairly good results were obtained at London with raw screened sewage, using coke as a filtering material.

The filters were made deeper, as great a depth as 13 feet of coke being used for some of the beds. It was not found that the greater depth gave a greater purification. It was found, however, that larger grains of coke, about the size of walnuts, gave certain advantages, such as greater capacity for sewage, and more rapid filling and emptying.

Such bacterial purification as was initiated in Massachusetts, and a modified form of which was used in London, is known as "intermittent filtration". Its great disadvantage is that the proper conditions are not maintained for the action of the species of bacteria which break up cellulose, and similar vegetable-tissue substances into gaseous compounds. Such substances, therefore, either clog the filter bed or, especially when coarser filtering material is used, are carried down into the interstices of the bed, and, in the course of a few years, greatly diminish its capacity. During the period when a filter bed is filled up with sewage the anaerobic bacteria act sufficiently to destroy some of the substances which tend to clog the filter, but these bacteria are distributed and some of them carried out during the emptying of the filter. During the resting stage when the air fills up the bulk of the interstices the action of the anaerobic bacteria must be altogether inhibited. It is during this period that the growth of aerobic bacteria flourishes and the air that has been drawn in is used in the growth of these to oxidize organic substances. Again, when the filter is filled up, the growth of the aerobic bacteria must be checked to a great extent. The action of these two groups of bacteria, whose environment should be different, is much better performed when the conditions are such that each can carry on its growth continuously without disturbance. Processes which promote this end have been developed.

A process which differs somewhat from simple intermittent filtration, was developed from experiments begun at Sutton, Surrey, England, in the year 1894. By the year 1896 the chemical precipitation and land disposal system used there was abandoned for a bacterial treatment. The tanks which had been used for the chemical precipitation were filled to a depth of 3½ feet with burnt ballast. The sewage after being screened so as to remove coarse solids was passed into the tanks where it remained in contact with the ballast for two hours, and, presumably, largely acted upon by anaerobic bacteria. The effluent of the tanks was passed on to filter beds of fine coke. The effluent from the filter beds was clear and inoffensive. The purification given by the tanks and filters combined, as shown by chemical analysis, was about eighty per cent., of which about two-thirds took place in the tanks. In 1899, screening was abandoned and the coarser suspended matter removed by using detritus tanks. These now have been converted into septic tanks.

As it was found that in the final stages of purification much oxygen was absorbed, and as it was found in many instances that periods of natural aeration of sewage filter beds improved the results, it occurred to various engineers that there might be a further gain by forcing in air under pressure. This was first tried experimentally at Lawrence, Massachusetts. Air under pressure was forced into filter beds

of gravel to which sewage was applied at a more rapid rate than usual. It was found, however, that the filter beds gradually clogged up and that the artificial aeration did not pay. The same principle was tried at Malvern, England, with gravel filter beds, and at Wolverhampton with coke beds. With the latter system, using chemically precipitated and sedimented sewage, a rate of over 260,000 gallons per acre per day was obtained with a purification of from 70 to 80 per cent. In a report to the Baltimore Sewage Commission, 1899, on the working of this plant it was stated that "The original idea that the mechanical forcing of air into the filtering material would enable the tank effluent to be applied continuously has been modified by the adoption of the half-day intermittent system." This goes to show that natural aeration is necessary. A system similar to those at Malvern and Wolverhampton was adopted at Newport, R. I., except that a separate artificial aeration of the sludge was attempted. According to Rideal, nineteen other installations on this principle were designed; but, he says, "Little is now heard of the method." Another aeration process is that of Colonel Ducat, in which the walls of the filter beds are made of three inch drain pipes set horizontally with their openings leading into the filtering material. The first beds constructed on this principle at Hendon, England, did not work well. Where such filters have been successful, chemical analyses of the sewage applied to them indicated that action by anaerobic bacteria had taken place in the sewers to an extent sufficient to prepare it for the aerobic bacteria of the filter. Trouble has arisen in winter through the freezing of the sewage, and steam boilers and steam pipes have had to be used.

Steam was regularly used in the Whittaker and Bryant "Thermal Aerobic Filter". This system consists of open septic tank treatment, the effluent of which is applied by revolving sprinklers to filter beds of coarse gas coke. There are shafts through the filtering material and perforated pipes leading to the air shafts. As the sewage reaches the sprinkler a jet of steam is blown into it to raise its temperature. Good results have been obtained by this method.

The most efficient bacterial treatment of sewage thus far invented is that in which the percolating filter is used. This is a bed of coarse broken stone, gravel, coke, or any convenient, fairly hard material, in pieces from an inch and a half to three-quarters of an inch in diameter—on the surface of which the sewage is distributed in a fine spray and gradually trickles down through the filtering material. The sewage must undergo some preliminary treatment, such as chemical precipitation or septic tank action—preferably the latter—to remove coarse solids in suspension. After passing through the percolating filters there is still a small amount of matter, largely of inorganic character, in suspension. This is removed by passing the effluent through setling basins.

The septic tank has been referred to several times in this article. One of its antecedents was the "Automatic Scavenger" of Mouras. Another was the "bacterial tank" of Scott-Moncrieff built at Ashstead, England, in 1891. This was a tank through which the sewage flowed upward over the surface of a bed of stones. Solid matter in suspension was entirely liquefied by the action of anaerobic bacteria. Mr. Moncrieff noticed the fact, also observed by the Massachusetts State Board of Health, that the action when carried too far gave an effluent so toxic in its character that the required subsequent action of anae-

robic bacteria was altogether prevented. The design of the modern septic tank and filtration system is credited to an English engineer named Cameron who established such a purification process at Exeter, England in 1895. The septic tank at Exeter is underground, and the top has an arched roof covered with earth to shut out light and air and prevent rapid changes of temperature. It is about 56 feet long, 18 feet wide, and 7 feet deep. Before entering it the sewage passes through a "grit chamber" at the end of the tank. The surface dimensions of the grit chamber are 18 ft. by 7 ft. and its depth is 10 ft. The sewage flows through the grit chamber and tank at the rate of about two feet per hour. A tough scum up to about 5 inches in thickness forms on it. After three years of operation there was only about four feet of a deposit of a peaty nature on the bottom. Chemical analysis shows that the deposit is about nine-tenths water. On this basis, allowing about fifty parts suspended solid matter per 100,000, the entire tank could have been filled with deposited matter about seven times, if the tank simply acted so as to cause sedimentation alone. The effluent from the tanks passes through distributing channels on to filter beds of coke or clinker. A remarkable feature of the Exeter plant is that the gases generated by the decomposition process in the tank are successfully used to light the plant. As, in the operation of various closed septic tank installations, explosions have resulted through the accidental ignition of the gases collected under the roof, septic tanks are now usually left uncovered or are covered only by a light roof which allows the gases to escape. A thick scum, such as the one already mentioned, forms a protective covering for the contents of the tank and gives favorable conditions for the action of anaerobic bacteria.

A short time ago a septic tank and filtration system was adopted for the sewage of Manchester, England. Baltimore, Md., and Columbus, O., are installing septic tank systems. Over thirty towns and cities in this country treat their sewage in septic tanks. Among those in this State recently adopting this system are Ithaca, where the tanks are just completed, and Seneca Falls, where such a system of disposal has just been approved of by a majority of the ratepayers.

The New York State Board of Health is doing much to forward the movement for sanitary disposal of sewage, by its inspection of existing systems and its recommendations regarding the installation of new sanitary disposal systems.

The best results that are now obtained in sewage purification seem to be those which are obtained by first subjecting the sewage to septic tank action, and then passing the effluent of the septic tanks through a series of filter beds. In the septic tank the sewage in its slow passage, about a foot per hour, is acted upon largely, by those species of anaerobic bacteria which liquefy solid matter, and break down albuminoids and other organic compounds into simpler compounds, including ammonia.

When the effluent of the tanks is passed through several beds of filtering material the bacteria naturally arrange themselves so that the species whose action produces nitrites first act upon it and oxidize the ammonia so as to produce nitrites. The effluent containing nitrites is then acted upon by other species of bacteria, in other filter beds farther along, which oxidize the nitrites into nitrates, thus completing the process of purification.

INTERCHANGEABLE MANUFACTURING.

By William A. Yerzley, M.E., Pd.B.*

The primitive methods of manufacture, whether of a mere implement, a simple mechanism, a machine of more or less complexity, or a construction of large size, fully justified the term coming down to us to cover even those purely mechanical processes contributing so much toward the world's industrial development. The method was that of shaping and sizing piece after piece by hand until the desired result was obtained. The construction of mechanism was a matter of "cutting and trying" each part until all worked properly together to make up an effective machine. The process was laborious, slow, and expensive and the result was not always reliable. The demand for an enlarged output and increased returns, coupled with a desire to save time and labor, led to the substitution of mechanical means for the hand processes and thence to the gradual development of a higher type of machinery. The character of the products was thereby made to depend less upon manual skill and the historical sense of the word manufacture became gradually more and more a mere thing of history. The appearance of improved machinery encouraged the more rapid development of industry. The growth of industry, in turn, gave additional impulse to the work of further perfecting manufacturing machinery and methods. Thus the advancement along these two companion lines of progress has been at an ever accelerating rate.

The steady increase in the volume of manufacturing and the demand for each variety of product in larger quantities brought about specialization in both machinery and labor, tending toward a more methodical, rapid, and generally more efficient system of production, at the same time establishing a more uniform grade of product. As a result of this specialization each workman has to do with the making of one or, at the most, only a few of the multifarious parts entering into the manufactured machine. It may be even that he has to do with only a single operation on those parts. This makes it impracticable to fit part to part and resort must be had to the methods of what is specifically known as interchangeable manufacturing, a term that we shall need to define somewhat fully.

By interchangeable manufacturing is meant such exact duplication in like parts that any one may serve equally well the purpose of any other in an assembled mechanism, machine, or other construction. This makes it unnecessary to select a particular piece to enter into the make-up of a particular machine and does away with all need of special fitting of part to part. When our grandmothers gathered together their odds and ends of cloth and pieced them into "crazy-patch" there was in the result no suggestion of interchangeability, but when such pieces were cut into uniform sizes and shapes and classified as to color there was brought into play the method all-important to the highly specialized industry of today. In building of irregularly sized stone, a mason must exercise care to place each piece where it will fit well and he may need occasionally to do chipping. If he lays brick, he gets the advantage of interchangeable manufacturing and may use at any time

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and in any place the block of material most conveniently at hand. So it is with the factory workman assembling watches. He has before him a number of compartments or boxes, each containing a great number of like parts. From each box in turn he takes a part at random, knowing that any one will fit as well into place as any other.

These few illustrations will serve to make our definition clear. At the same time they indicate some of the mechanical advantages of exact duplication. We have seen how specialization in machinery and in labor breaks up the work of manufacturing into independent and easily managed details. This results in a greater concentration of effort and more efficient work in getting out the separate parts. We see, also, that these parts are more readily assembled into the complete machine and that the time of assembling is thereby reduced to a minimum. But the gain does not end here. Every interchangeably manufactured machine leaving the factory carries with it a lasting advantage in that when taken to any distant point it may be as accurately fitted with repairs as in the room in which it was originally assembled. Any broken part, any excessively worn or otherwise injured piece may be replaced on short notice by one of its counterparts the factory is daily turning out or is holding in reserve store. Such renewal involves no special work either at the factory or at the machine. In this way, any and all parts may be successively renewed until not a piece of the old machine remains and in its place stands a new, and yet essentially the same machine.

Great as are these mechanical advantages in themselves, their chief source of value lies in the fast that they help to bring about a great reduction in the cost of production. Not only are profits swelled, but manufactures that otherwise could not be offered except at a prohibitive figure may be marketed at a price that permits of their going into general use. If you would appreciate this fully, have a sewing machine built in a general shop or ask your jeweler to make you an alarm clock. In some of the most complicated and most accurately built machinery the work of finishing the castings is less than the cost of the material itself and there is work in which the minimum amount of scrap more than covers the cost of manufacturing the parts. The perfection of machinery and tools has reduced the cost of bicycles to less than one-fifth of what formerly obtained and you may now buy a watch for less than it will cost to have it cleaned.

This accurate duplication of parts is accomplished with the rapidity necessary to a low cost of production through the use of special machinery and tools and such appliances as templets, gages, jigs, and fixtures. It is to be understood that by special tools may sometimes be meant not only the simpler devices but also the more complicated mechanisms designed to turn out a specific product. A tool was originally a hand implement only. Of course it remained essentially the same thing after a machine was invented to handle it. By extension, the machine itself came to be called a tool or, more specifically, a machine tool. As one of the most important machines of this sort may be mentioned the screw machine, which is nothing more nor less than a highly perfected turret lathe. It is capable of turning out with great rapidity and precision an almost endless variety of work that to be finished requires only turning, boring, facing, or threading, or any two or more of these operations. This machine, when fitted with supplementary machines on the turret, may also accomplish a variety of

other work, such as milling, slitting, etc., the main spindle being held at rest while these operations are being performed. As a rule, the product is made from rolled stock fed automatically through the hollow spindle and one operator may take care of several machines. Machines of this sort and many much more limited in scope, some capable of manufacturing one specific part or performing one specific operation only, constitute the most complicated part of the manufacturing equipment. It is in them that mechanical genius and accuracy of construction have been combined in the highest degree.

Among other aids in interchangeable manufacturing, are the great variety of templets, gages, punches, dies; drilling, reaming, and tapping jigs; and fixtures for milling, boring, profiling, filing, grinding, riveting, soldering, assembling, etc. In the shops, the majority of these are spoken of as "rigs".

It is not alone in the production of light and accurate machinery and delicate apparatus that the methods of interchangeable manufacturing are adopted. They are also employed in the building of heavier machinery where accuracy is important and in the doing of work that may properly be classed as rough, where no very great accuracy is required. Many finished products consisting each of a single piece are made in exact duplication, though there may be no more need of their being interchangeable than that two key rings be alike. The rough work may need to be roughly interchangeable but the sole reason for using the special process is that the work may be most cheaply done in that way. In general, the methods of handling rough work are about the same as in more accurate work of the same weight, the difference being simply one of refinement. In heavy work the case is quite different. Highly specialized methods are not easily applied, and the means employed for making the parts interchangeable may involve an increase in the manufacturing expense. The processes become less automatic and the primitive method of "cut and try" reigns supreme, though the fitting of part to part is avoided. The manufacture of the heavier machinery so that the parts shall be interchangeable is a matter of working to micro-scale, or of fitting to templets, gages, etc. The limit gage becomes the chief reliance. Let us see what we mean by a limit gage.

In no interchangeable manufacturing is it necessary that the like parts show no appreciable variation in similar dimensions. Such absolute precision is not attempted. All that is required is that the variation shall be kept within limits close enough to meet practical demands or to hold the grade of the product up to a given standard of accuracy. Even where the highest possible precision is sought, allowance must be made for the limitations of manufacturing methods. Let us suppose a case in which a part is to have an outside diameter of 5 inches, and that a maximum deviation of 0.002 of an inch is permissible on either side of that dimension. Two gages will be made, one measuring 5.002 inches, the other 4.998 inches. In the process of making the part, it is so far reduced that the first gage will pass over but not so far that the second will. Its diameter will be, then, somewhere between these two extreme figures and the piece will meet the set requirements of interchangeability. These two limit gages are usually made in the same piece and marked with the signs plus and minus respectively, and in the vernacular of the workmen are called the "go" and the "not go" gages. Gages of this sort are also used in the lighter

automatic manufacturing for the purpose of testing and checking up the work. The permissible variation may be as small as a fraction of the one-thousandth of an inch. Sometimes it is not practicable to manufacture so that all like parts may be interchangeable and it becomes necessary to separate them by the use of successive limit gages into batches that will be respectively interchangeable with similar batches of parts with which these are to fifit.

The introduction of special machinery and tools lowers the cost of production not only because it increases the mechanical efficiency of the manufacturing plant, but also because it enables the employment of a cheaper grade of wage earners. The intelligence and the skill are embodied in as high a degree as possible in the machine itself, so that the operator need have only a small measure of either. The designer aims to make his machine and tools what he calls "fool proof". The man who plans these special machines and tools must be perfectly familiar with shop methods, especially as applied to the work with which his creations will have to do, and he must be resourceful as an inventor.

The producing part of a modern machine manufactory consists of the engineering department and the shops. In the engineering department the machines being manufactured as well as the tools used are designed. In some, the same designers are engaged on both machines and tools; in others, each line of work has its own designers working under the same immediate chief, while in still others the tool designing is done in a department all its own. With few exceptions, the tool-making is done in what is called the tool-room, distinct from and independent of the manufacturing shops. The machine designers and the tool designers are about on a par, but the "tool-maker" is an aristocrat among mechanics and his appliances fill a wide gap between him and the man, (or more likely the boy) who is the direct producer of the manufactured product.

NEW COURSES OF INSTRUCTION—1907-1908.

II. SEMESTER.

Beginning with the second semester of the current college year, students of the freshman class who have given, during the first semester, evidence of a command of English, substitute either one or two semester hours in psychology or logic. During this semester the elective subject is psychology. The students' papers submitted in these subjects, however, are scrutinized for English as in all other courses.

Psychology. Physiological basis; characteristics and functions of mental life. Order of our thought. Purposive and automatic action and habit. General laws of mental action; mental training; mental fatigue, evolution of the human intellect; etc. II.; arrange time; (1) or (2). Professor Michel.

Hydraulic Construction. C.E. 15. Modern constructions; dams, conduits, water power canals, and irrigation works. Prerequisite, Mechanics 3, (Hydraulics). Lectures. I.; arrange time; (2). Professor McLeod.

Astronomical Observations and Computations. C.E. 22. Observations and computations to determine time, latitude, and azimuth.

Prerequisite, C.E. 8, (Astronomy). II.; arrange time; (1). Professor McLeod.

Hydraulic Design. C.E. 38. Design of dams, conduits, penstocks and turbines; irrigation canals and tunnels. Prerequisite, Mechanics 3, (Hydraulics). Computations, drawings, etc. II.; arrange time; (2). Professor McLeod.

Mechanics of Reinforced Concrete. Mechanics 6. Theory of reinforced columns, beams, arches, slabs, walls; graphical analysis of arches. Prerequisite, Mechanics 2. Lectures and problems. II.; arrange time; (2) or (3). Professor McLeod.

Advanced Calculus. Math. 9. Advanced work in differential and integral calculus; mechanical differentiation and integration; calculus of imaginaries; hyperbolic functions; elliptic integrals and elliptic functions defined. Lectures, accompanied by assigned reading and problems. Prerequisite, Math. 5. II.; arrange time; (2) or (3). Professor Barton.

Determinants. Math. 10. Definitions; minor determinants; addition and multiplication of determinants; rectangular arrays; solution of equations by means of determinants; symmetrical determinants; skew determinants. II.; arrange time; (1) or (2). Professor Barton.

Gas Engineering. M.E. 12. Materials, apparatus, process of manufacture, and characteristics of coal gas, carbureted water gas and producer gas. Gas distribution; low and high pressure system; flow of gas in pipes; costs of laying mains. Industrial applications of gas; illumination, heat, power, with special attention to producer gas and its utilization in gas-engines, with study of a modern producer gas power plant. Prerequisite, M. E. 7. II.; Tuesday, 2; (1). Professor Williams.

CHANGES IN FIELD DAY.

Beginning with the second semester, January 27, 1908, the field day heretofore assigned for Saturday will be changed to Monday, so that all lines of practical instruction may be carried on continuously during the morning and afternoon; that is, surveying, field practice, railroad work, drafting, designing, shop work, and all classes in laboratory instruction, in the practice periods of three hours, each, morning and afternoon.

All of the lectures, recitations and class-room work heretofore assigned to the morning periods will be given as usual, and as arranged for the second semester, from Tuesday to Saturday inclusive, from 8 a. m. to 12 o'clock, chapel exercises being held as usual at 9 o'clock. The arrangements for the afternoon classes remain practically as heretofore, Monday to Friday inclusive. It is expected that this arrangement will give much more satisfaction and be more flexible as, owing to the large classes, much of the practice and class room work has to be given in double sections.

CLARKSON TECH. ALUMNI ASSOCIATION.

The third annual meeting of the Alumni Association was held in the Library of the School, at 2:30 o'clock, in the afternoon, of Founder's Day, November 30, 1907. It was followed, at 4:30 o'clock, by the

second annual meeting of the Clarkson Engineering Assembly, held jointly with the Alumni representatives present.

The following Alumni were present: George A. Stebbins, '01, Watertown, N. Y.; Lloyd W. Greene, '05, Watertown, N. Y.; Albert L. Sayer, '05, Ogdensburg, N. Y.; Ivan R. Wellington, '07, West Stockholm, N. Y.; Ray D. Wiswell, '07, Albany, N. Y.

The members of the Faculty and the visiting Alumni dined together at the Albion House, upon the adjournment of the Assembly.

The Outlook of the Alumni Association for 1908.

By H. F. Halladay, '02, President.

Although we have entered now upon the fourth year of our existence as "The Clarkson Tech. Alumni Association," it was but very recently however that we felt recognized, as an organization, when we could and did make our voice heard and felt, by our Alumni representatives in the Clarkson Engineering Assembly.

This year we will not only continue this program, but carry out our plans by more concerted action. To this end we hope to interest more of our Alumni in the Association and solicit their hearty cooperation.

The Association can play an important part in the future welfare and progress of Alma Mater. Now seems to be the opportune time to begin to act in the furtherance of an object the absence of which we so greatly deplored, while students at the Clarkson Tech., a Gymnasium.

The Tech. must and is going to have a gymnasium. Where is the Alumnus that did not miss, while a student at the Tech., that physical and necessary training and exercise to be obtained only in a well-equipped gymnasium?

How many times did we not watch games of foot-ball, base-ball, basket-ball, track meets, etc., and say to ourselves, "If our men had a Gym. in which to train we could put it all over those fellows."

Were we still at the Tech. we would make the same remarks, for the men are still trying to engage in athletic sports, without any accommodations for training.

Nowadays a gymnasium is an educational necessity. All colleges and universities, yes, even high schools and many grammar schools have provided or are speedily providing for this obvious need. What profits a well developed mind in a weak, sickly body? And yet the Tech really makes this demand upon its students in training for life; i. e., develop your mind at the expense of your body. It is especially an engineer, which it is aimed should be the product of such training, who should stand head and shoulders above men of almost all other professions, in order to plan and carry out successfully the great industrial and constructive works of our day; it is he who must be strong to do and to endure, physically as well as intellectually.

The Tech. with the present equipment has served well this educational purpose of such a training. Now let also an equipment for physical training put the Clarkson Memorial into the very front rank. Plans and specifications have been prepared for the erection of the building, and we are now trying to complete our financial arrangements. Nearly every Alumnus is interested, but let all manifest an

active interest and enthusiasm in the work, and in anticipating the successful completion of such a worthy enterprise.

Again, feeling that our interest in Alma Mater does not and should not end at graduation from the Institution, our Association, at its last meeting held at Utica, N. Y., considered the question of incorporation. If this measure is carried through we shall be very much stronger, and all of our work made more effective. Our own interests, as well as those of the students, may then be brought to the consideration of the authorities more readily and advocated more successfully. We sincerely hope that such mutual relations of the former and present school community will greatly enhance the usefulness of life of those now engaged in their profession, as well as afford abundant assistance to the graduates in the years to come.

Should these two main projects of our Association, i. e., the raising of our guaranteed sum of three thousand dollars, by the end of this year, and the incorporation of the Clarkson Tech. Alumni, end successfully, then we will feel that we have accomplished, at least, some of the task set before us this year, something that will speak in no uncertain way for the Alumni, and that we believe will also greatly benefit our beloved Alma Mater.

The Work of the Alumni Association.

By F. C. Zapf, '04, Secretary.

The Clarkson Tech. Alumni Association held a meeting in Utica, N. Y., December 21, 1907, and elected as officers for the ensuing year: H. F. Halladay, '02, President; R. B. Leonard, '06, Vice President; F. C. Zapf, '04, Secretary; H. S. Dunsford, '05, Treasurer; and as additional representatives to the Clarkson Engineering Assembly, for one year; N. L. Rea, '01; S. I. Wailes, '01; C. A. Pohl, '02, and B. L. Delack, '03.

Among the important matters considered and acted upon were, incorporation of the Association, which was referred to a committee for investigation; the gymnasium building project; revision of the Association Constitution, referred to the Executive Committee; and the Publication of an Alumni Handbook and Employment Bulletin. The reports of the officers were optimistic in tone, and progress was the watch-word from all divisions of the work.

The organization of an efficient Alumni Association in a college whose functions of usefulness have extended over only a few years is not a matter of weeks and months. This was ably pointed out by President Pohl in his report. It requires a period of years, with much labor and careful attention to details and conditions.

Clarkson men who graduated in the first classes, and who, from press of business, and distance from Alma Mater, have not availed themselves of the opportunity of returning to her walls at some appropriate season of the year, such as Founder's Day, or Commencement Week, find it difficult to realize the great changes that have taken place.

In all this time standards of scholarship have been gradually raised, social relationships have developed, class spirit has become a more tangible thing, college legends and traditions have been fostered, and fraternalism has manifested itself. A return to the once familiar

halls reveals to the graduate of five years' standing, for instance, changes of a remarkable character, and changes of which he little dreamed "in his day".

The welcome which greets him on such a return, however, is not that of a stranger in a strange land. The graduate is received, rather as the conquering hero, as one who has been making history for the Institution which is now happy to receive him as an honored guest. It is now that he feels almost ashamed to think that in some busy moment he has imagined that his relation to Alma Mater, the Institution of his professional birth, ceased when he graduated and left her doors, diploma in hand, to take up his problem in a busy, pressing world, and to acquit himself honorably in all the battles of life. The graduate sees that as the child bears an indissoluble relation to the parent, so his relation to Alma Mater is an inseparable one. As once a part of her being and now a product of her institutional life, his interests are firmly bound to Alma Mater, and his life must henceforth necessarily be given, in part at least, to strengthen and increase her fullness of life.

It is then that each Alumnus stands ready to take up and forward the interests of his college through every available channel. The Alumni Association feels his influence. The Faculty knows of him because he is directing worthy young men to them for instruction. He is always keeping in touch with every plan of the Institution, and his influence and interest work wonders in its healthy growth and steady advancement.

We have not yet all become aware of the possibilities awaiting us in working thus unitedly for the Clarkson Tech, through the Alumni Association. To one familiar with the work and details of larger Alumni Associations, however, that of the Clarkson Tech. is now seen to be gradually taking form and to be entering upon its real mission and usefulness.

Let us work together, therefore, let us stand firmly by the Clarkson Memorial in order to make the year 1908 one of the greatest progress in its history.

ALUMNI PERSONALS.

1900.

Julius R. Jacobson is now engaged in foreign construction work for the General Electric Co. and is located with San Paulo Tramway, Light and Power Co., San Paulo, Brazil.

1904.

F. C. Zapf, chemist and in the research department of the General Electric Co., has been elected secretary of the newly-organized Schenectady branch, of the American Chemical Society. The meetings are held in the chemical laboratory of Union College, and the organization is open to chemists in Schenectady and the surrounding cities, so as to form a strong local branch of the national society and secure co-operation through monthly meetings.

1905.

Harold S. Dunsford has been promoted to be assistant foreman in the turbine shops of the General Electric Co., at Schenectady. At the end of the year it is customary for the company to select three men from the testing department. When the time came last year two

Clarkson men Messrs. H. S. Dunsford of Watertown, N. Y. and S. S. Stone, of Potsdam, were selected of the three. Mr. Stone later went to the Denver office where he occupies a very desirable position. Mr. Dunsford was in this department only nine months when he was promoted to be assistant foreman, with fifty men under his supervision. Since assuming his new duties almost all of his time has been spent on commissions for the company installing and repairing of turbines throughout the country. He lately returned from Camden, N. J., where he installed the turbines used for generating the electric power on the new battleship, New Hampshire.

S. S. Stone has become connected with the Colorado Yale Marble Co., having charge of the extensive power house and electrical developments of the Company. The works are located at Marble, Gunnison Co., Colorado, at an elevation of eight thousand feet above sea level, about three hundred miles west of Denver and eighty miles south of Glenwood Springs. Electric water power is developed under three hundred and eighty feet head of water, and the transmission is at six thousand six hundred volts.

1906.

Ceylon R. Cady, with Messrs. Hinchman & Grylls, Engineers and Architects, of Detroit, Mich., spent Christmas with Mr. and Mrs. R. J. Burrows, at Flint, Mich., where Mr. Burrows is located with the Weston Mott Company.

Ralph B. Leonard, recently with the General Electric Company, has been connected with the Utica Gas & Electric Company, having charge of installation work. He has also done some very important work in the meter department, and is now foreman of this department. In connection with meter work, many tests of motors are being made, to ascertain the commercial conditions of loading, for service charges.

Arthur B. McIntyre, has been with the General Electric Company, Schenectady, N. Y., since graduation, and says it is a helpful field where one gets a good deal of experience and becomes acquainted with many different types of apparatus in a comparatively short time.

Howard J. Phelps, in the Denver office of Dr. F. A. C. Perrine, consulting engineer, of New York City, writes of his work in connection with the development of about 4000 H.P., ultimate capacity, hydro-electric, net head of four hundred and fifty feet, and a twenty-two thousand volt line of about eighteen miles, and states, "That is where I was when your first letter came, right out in the middle of the Rockies; in fact, we were about fifteen miles north of Leadville, and the village of Dillon has an elevation of eigh thousand eight hundred feet above sea-level. You can imagine the rest." Mr. Phelps has also recently had considerable work in connection with the hydraulic and electric development of the Summit County Power Co., of Colorado.

1907.

Claude F. Gleason, Junior Engineer in the United States Reclamation Service, is at present located with Mr. H. J. Doolittle, Assistant Engineer, on the "Yakima-Triton" irrigation project. This is one of the smaller of several projects now under way in the State of Washington, and will water about thirty-five thousand acres of grain and fruit land lying west of the city of North Yakima. The waters of the Triton river are diverted, and delivered to the irrigable land by a main canal, twelve miles in length. Of this distance, about one-third consists of tunnels. Practically the entire length is lined with reinforced

concrete, as the slopes of the cannon along which the canal is carried being too steep to allow of sufficient cross section for an unlined, low-velocity section. Mr. Gleason reports progress and much interesting work, and that he has been getting some rather strenuous instrument work on location and cross-sectioning; also precise work on tunnel alignment and grades.

Charles D. Owen, with the General Electric Company, has recently joined the Edison Mandolin Club, of Schenectady, N. Y., and has continued his interest in the glee club and orchestra work.

Mr. Ivan R. Wellington (A.B., St. Lawrence University, 1901), B. S. in civil engineering, Clarkson Tech., '07, has recently been appointed on the civil engineering corps of the Madeira-Mamore Railroad Company, with headquarters at San Antonio, Brazil. He expects to sail from New York, the first week in February. This railroad has been recently projected from San Antonio, on the Maderia river, a branch of the Amazon, into the unexplored forests of Brazil, and from the terminal at the junction of the Mamore river, its proposed extension will reach on into the rich gold fields of northern Bolivia, and thence to a point near the Peru boundary line. After graduation Mr. Wellington was located in New York City, at work in the civil engineering department of the tunnel division, of the Penn., New York and Long Island R. R. Company.

CLARKSON ENGINEERING ASSEMBLY.

Lecture on Reinforced Concrete Construction.

The lecture before the Assembly and friends of the School, Thursday evening, November 21, 1907, was well attended by an appreciative audience. Mr. R. N. Willard, B.S., (Harvard, 1900), who has been in charge of the construction of the new reinforced concrete dam for the Racquette River Paper Co., near Sissonville, had prepared a well selected series of views and photographs for illustration. From these views lantern slides had been made by the photographic department of the Tech., supplemented by a few slides from views which the students took when on a visit of inspection to the site of the dam.

Mr. Willard gave quite an account of the origin and growth of this new method of construction, by reinforcing the older concrete work with steel, used most widely in the form at present of corrugated bars, of square section for the type of construction which he has in hand. He also showed its thorough adaptibility for buildings, arches, bridges, besides its present extensive use in hydraulic developments. Mr. Willard's remarks as to methods of work, and of dealing with men in construction, were heartily received and applauded. The Clarkson Tech. Orchestra gave two choice selections, before the lcture, undr direction of Mr. Clute, '11, and the management of the Welker Brothers, '09.

The Annual Meeting of the Assembly.

The second annual meeting of the Assembly was held in the Library of the School, and jointly with Alumni representatives, at 4:30 P. M., on Founder's Day, November 30, 1907. The following Alumni

were present: George A. Stebbins, '01, Watertown, N. Y., Lloyd W. Greene, '05, Watertown, N. Y.; Albert L. Sayer, '05, Ogdensburg, N. Y., Ivan R. Wellington, '07, West Stockholm, N. Y.; and Ray D. Wiswell, '07, Albany, N. Y. Reports were presented by the executive committee, Director, chairman; finance committee, Prof. Williams, chairman; gymnasium building committee, Director, chairman; committee on constitution, by-laws, and rules of order, Prof. Michel, chairman.

A constitutional amendment of the Asembly was recently passed by both houses, representing the vote of the Faculty, Alumni and the student body. By this amendment there will be three representatives of the students from each of the regular classs, instead of two as heretofore, making twelve members of the lower house. The upper house is composed of thirteen members of the instructional force in residence and eight alumni, annually elected from the alumni association. The new student members recently elected pursuant to this amendment are: C. S. Merriman, '08; H. N. Scofield, '09,; A. A. Griffin, '10, and R. E. Leonard, '11.

The officers of the Assembly were elected at the annual meeting, for 1907-1908, to fill places of those retiring: J. J. Grieb, '08, Treasurer; and B. W. Morse, '09, Secretary. Messrs. M. L. Stack, '05, and R. L. Safford, '08, were elected members of the Board of Trustees of the Assembly, for three years, to take places of Messrs. C. A. Pohl, '02, and F. R. Finch, '07, incorporating trustees, for one year.

Of the newly elected officers of the Assembly, Mr. Stack, '05, B. S. in Electrical Engineering, is with the Connecticut Company, at West Haven, Conn. Mr. Safford, '08, holds the Librarian scholarship, at the Tech.; Mr. Grieb, '08, the scholarship as Tutor in Mathematics; and Mr. Morse, '09, the scholarship for Assistant in Physics and Electrical Laboratory.

The amount of money raised by the Assembly during the past year, for the Tech. Gymnasium building fund, and reported by the financial committee, is over one thousand dollars, toward the five thousand required to secure the equal sum of five thousand guaranteed on this condition, by Miss Lavinia Clarkson, one of the original Founders of the School.

Newly Elected Representatives to the Assembly.

The following are the alumni representatives of the Assembly, for 1907-1908, elected at the meeting of the Alumni Association, held at Utica, N. Y., December 21, 1907: the four officers of the alumni association: H. F. Halladay, '02, president; R. B. Leonard, '06, vice-president; F. C. Zapf, '04, secretary; and H. S. Dunsford, '05, treasurer; and four members of the alumni association at large: Messrs. N. L. Rea, '01, S. I. Wailes, '01, C. A. Pohl, '02, B. L. Delack, '03.

The result of the recent election in the Junior class, for representative to the Assembly was the choice of Mr. Byron F. Burch, of Potsdam, N. Y., to serve for two years, beginning January 18, 1908, vice George E. Welker, retired, after serving the elective term of two years from January 18, 1906.

THE YOUNG MEN'S CHRISTIAN ASSOCIATION.

The current year of the Association has been the most successful since its organization in 1904, both as to active membership and attendance at the meetings. These conditions incite to still greater interest in the work of the Association and more earnest activity among its members. Much credit is due to the leaders who have striven to make their respective meetings both interesting and profitable.

During the semester just passed we were fortunate to have had some non-active members as teachers and leaders.. Rev. J. M. Steele, Rev. E. M. Wilson, and Rev. F. L. Masseck, of Potsdam, N. Y., greatly assisted and encouraged our work by their interesting, helpful, and inspiring addresses.

In selecting and arranging the several topics for the coming semester, it has been the purpose of the Committee again to have some dates given without indicating either topics or leaders. This permits the invitation of outside persons to act as leaders. Broader and perhaps new ideas and thoughts will thereby be introduced into our work, and the interest and activity increased.

The topics are mainly chosen with the view of dealing with the practical side of religious life, and especially that of college students. We recognize and feel, also, the need of Christian enlightenment in education, in the true sense of the word, and the building up of the moral and spiritual character of the future citizen, in addition to the training and education he may receive for his professional career. This feature of the Association's influence in education and spiritual uplift will be found to a certain extent, at least, in our Friday evening meetings.

In order to maintain and increase the efficiency of our local Association, we have endeavored to send representative members as delegates to the annual Conference, held at Northfield, Mass. Here Y. M. C. A. men of nearly all of the Christian Associations of Eastern colleges meet for mutual instruction and advice. Our success thus far this year in arousing interest in this direction, leads us again to expect to carry out the plan this summer.

At the annual election of officers, the following were elected for 1908: President, Lloyd W. Weed, '10; Vice-President, John L. Maynard, '11; Secretary and Treasurer, Harold G. Corwin, '10.

To all members of the school community, both faculty and students, we extend a cordial invitation to attend the meetings of the Association, held every Friday evening, at 7 o'clock in the Tech. Chapel hall.

Y. M. C. A. Topics, II Semester—1907-1908.

Jan. 31—Union with Christ necessary. John 15:1-8. G. Tracy.

Feb. 7—Different work given different people. I Cor. 12:12-28. J. R. Hardenburgh.

Feb. 14—Supplied.

Feb. 21—Sin causes moral insensibility. Matt. 13:14-15. C. S. Merriman.

Feb. 28—"I can" and "I can't." Isa. 35:3-4; 30:15-18. G. M. Rodger.

March 6—The government of temper. Prov. 16:32, 19;James 1: 19-20. Hervey Scofield.

March 13—The narrow way, and the broad way. Luke 13:23-30. L. W. Weed.

March 20. The Lord is our strength. Psa. 46:1; Psa. 68:34-35. Harvey M. Merriman.

March 27—Supplied

April 3—Hearers and Doers of the Word. Jam. 1:22-23; Rom. 2: 13. J. M. Cole.

April 10—We are witnesses for Christ. Isa. 43:10-12; Isa. 44:8. J. L. Maynard.

May 1—The duties of the day. Prov. 24:30-34; Rom. 12:11. W. W. Weed.

May 8—The true center of life. Psa. 15:1-10. Jas. S. S. Jones.

May 15—Wanted: Men for Gideon's band. Judg. 7:2-7. A. H. Emerson.

May 22—Trust in the Lord. Psa. 37:3-7; 144:1-2. Harry R. Jones.

May 29—Supplied.

June 5—Our lives for others. I John 3:13-16. George D. Cowie.

CLARKSON TECH. ORCHESTRA MUSICALE.

On Friday evening, January 10, 1908, at eight o'clock, the first Tech. Musicale of the New Year was rendered in an excellent manner before the Tech. Community in the Assembly Hall of the School. The following program was given:

Program.

Overture—Carmen.... .. ..Bizet
Orchestra.

Vocal Solo.. .. ..Selected
Miss Lillian Cummings.

Selection—Merry Widow.. .. ..Lehar
Orchestra.

Cornet Solo—Crystal Beach Polka.. .. ..Boos
S. A. Clute

Finale—George Washington Jr. .. ..Cohan
Orchestra.

The orchestral numbers were rendered in splendid style and execution, under the direction of Mr. S. A. Clute, '11, and these were called for again by encores to which the orchestra was obliged to respond. The vocal solos rendered by Miss Lillian Cummings, of the Crane Normal Institute of Music, were exceptionally fine and were very thoroughly appreciated by all of those in attendance The cornet solo, by Mr. Clute, the director of the orchestra, with the orchestral accompaniment, was rendered with his usual excellent execution and interpretation. The Welker Brothers, '09, Managers of the Tech. Orchestra and holders of the Clarkson Musical Scholarships for 1907 and 1908, have just reasons to feel proud of the high standard attained and type of orchestra which they have been able to assemble from among the Tech. students, and they will certainly endeavor to provide even greater activities in the future in this department of the Institution.

Thomas S. Clarkson

MEMORIAL SCHOOL OF TECHNOLOGY

Potsdam, N. Y.

A College of Engineering for the Training of Men.

This Institution was founded in 1895. It was chartered, March 19, 1896, by the Regents of the University of the State of New York, and opened its doors to students in September of the same year.

The object of the Clarkson foundation is to provide technological education of college grade.

The School is located at Potsdam, St. Lawrence Co., N. Y., on the Rome, Watertown and Ogdensburg division of the New York Central Railroad. It may be reached from all points through the connections of this road in New York State and Canada.

For admission there is required a thorough four year high school preparation. The regular courses extend over four years and comprise instruction in language, literature and history, mathematics, the natural and economic sciences, engineering and technology. The instruction is largely taken in common, during the first two years, and provides the elements of a liberal education. Based upon similar instruction in the fundamental principles of the applied sciences, the subsequent training aims to develop the habit of clear and accurate thinking, familiarizing the student with practical methods of executing work and projects and scientific methods of conducting investigations.

The technical instruction of the last two years, in theory and practice, affords substantial preparation for immediate usefulness after graduation by intelligent application of principles to the successful mastery of the details of the chosen field of work. A foundation is also laid for those who intend, by further study, to specialize in some particular branch of their profession.

The four year courses in engineering afford thorough preparation for those who intend to engage in the professions of chemical, civil, electrical or mechanical engineering. They lead to the degree of Bachelor of Science in the major subject pursued; namely, chemical, civil, electrical and mechanical engineering. The degree of B.S. is conferred and certified by a diploma issued by the Regents of the University of the State of New York, jointly with the Trustees of the Thomas S. Clarkson Memorial School of Technology.

This School is included by the United States Civil Service Commission in the list of approved technical schools, diploma from which entitles the holder to promotion in the Engineer Department at Large; and in the list of accepted institutions entitled to share in the benefits of the Carnegie Foundation for the Advancement of Teaching.